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ABSTRACT

The role of artificial intelligence expert systems in administrative issues in special education is examined. Mandate Consultant (MC) is one such system designed to provide a second opinion on the consistency of school officials' actions in implementing the Individualized Education Program team process. MC employs rules based on the Education For All Handicapped Children Act. Examples of a typical MC consultation illustrate how rules are used to determine which questions to ask and which conclusion to infer. The ways in which MC uses backchaining to determine if rules succeed or fail are explained and examples cited. Outcomes of the consultation are noted, as are additional features such as the opportunity to query the program at any point in the consultation regarding its immediate conclusions. (CL)

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Technical Paper

Mandate Consultant: An Expert System for Examining the Implementation of Special Education Regulations

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Implications of the Law

During the past several decades, general acceptance of public education of handicapped children in the United States has grown rapidly (Henderson & Hage, 1979). This general acceptance led to the enactment of the 1975 Education for All Handicapped Children Act (Smith, 1981). Three key technical terms appearing in the Act include: "free appropriate public education" (FAPE), "least restrictive environment" (LRE), and "individualized education program" (IEP) (Zirkel, 1983). The Act assures that all children have available to them a free appropriate public education. To the maximum extent appropriate, handicapped children are to be educated with children who are not handicapped, that is, educated in the least restrictive environment. The written IEP identifies the plan for meeting the FAPE and LRE requirements. A team that includes at least school representatives and parents meets to develop the IEP specifying the child's educational program.

The IEP "process" serves as a forum within which parents and school officials reach agreement on the content and provision of the handicapped child's education. Where school and parents cannot agree upon an educational plan for the child, an impartial due process hearing officer serves as an arbitrator to achieve resolution (Kammerlohr, Henderson, & Rock, 1983).

The due process provisions of the Act protect the rights of parents and the handicapped child. In addition, it makes parents

partners in the educational decision-making process. For the most part, the interaction between school officials and parents results in agreement on educational programs. In other instances, however, the interaction is less than constructive; relationships are strained, and agreement does not occur. When this happens, parents or school officials can request the involvement of an impartial hearing officer to resolve the situation. The hearing officer reviews documents (evaluations, progress reports, etc.) from the child's file and listens to testimony from the involved parties. Then the officer makes a ruling based on the intent of the Act and state regulations.

Need

While the provision of due process and implementation of the due process hearing is essential to the intent of the Education of All Handicapped Children Act, some problems have been associated with the Act's implementation. First, many due process hearings address issues which lack substance and cause delays and interruptions in appropriate services for handicapped students (Budoff, Orenstein, & Abramson, 1981). Typical issues appealed by parents include categorization of the handicapped child (for example, a label of learning disabled versus mildly mentally handicapped), disputes relating to services (for example, receiving speech therapy services once per week versus several times per week), and placement disputes (for example, one hour per day in the regular classroom setting versus several hours). A review of due process decisions, concerning issues such as those described, indicates that no one clearly "won" or

"lost" in many of these cases. Rather, schools were frequently ordered to develop more explicit educational plans to address the parent's concerns (Budoff et al., 1981). Thus, school officials could have avoided many dues process hearings during the initial development phase of the child's educational program.

Regardless of an issue's significance, delays and interruptions in a child's educational program often accompany the hearing process. The regulations of the Education of All Handicapped Children Act state that services for the handicapped child should be maintained during the hearing process. Nonetheless, hearing officers have other obligations, thus, scheduling due process hearings to limit, if not avoid, delay can be difficult (Smith, 1981). While the handicapped child may continue services during delays, the services may not be appropriate.

A second major concern with due process hearings is cost. A cost analysis done in the late 1970's showed the average due process hearing costs from $2,000 to $4,000 (Henderson & Hage, 1979). The school district bears this cost regardless of whether parents or school officials request the hearing. The $4,000 figure approaches the current average cost for educating a handicapped student annually; also, this figure is nearly twice the current average cost for educating a nonhandicapped student (Belsches-Simmons & Lines, 1984). From this perspective, a more cost-effective means of dealing with differences between parents of handicapped children and school officials would be desirable (Kammerlohr et al., 1983).

A third major problem associated with due process hearings

is related to an underlying requirement of due process, that is, the hearing officer should be impartial and competent (Salend & Zirkel, 1984). Federal regulations clearly state that hearing officers must be impartial. Although regulations specifically indicate that a hearing officer may not be an employee of the local school district involved in the case (Ekstrand, 1979), no other specific criteria for determining impartiality are provided.

In addition, the federal regulations do not specify the background or training necessary for hearing officers (Smith, 1981). Thus, the backgrounds of hearing officers vary greatly (Ekstrand, 1979). In a study of hearing officers in North Carolina, the diversified professions and backgrounds included a homemaker, postmaster, and research biologist (Turnbull, Strickland, & Turnbull, 1981). However the diversity of professions and backgrounds do not weaken the process as much as the lack of training, or more appropriately, the disparity of training for hearing officers (Turnbull, Turnbull, & Strickland, 1979). Generally, the state education agency has the responsibility for training hearing officers in its state. While there have been ongoing efforts to meet this responsibility, great variation from state to state has occurred (Smith, 1981). Unfortunately, state agency's selection of hearing officers has not consistently attended to competence as well as impartiality, thus, current due process hearings do not ensure necessarily equitable and effective educational decisions (Salend & Zirkel, 1984).

The Problem

The literature clearly documents problems associated with many due process hearings. First, disagreement over relatively minor issues can delay services to students. Secondly, hearings are costly. And thirdly, the knowledge and skill of hearing officers varies greatly. Clearly, these problems substantiate the need to resolve disagreement between school officials and parents prior to formal due process hearings (Belsches-Simmons & Lines, 1984). School officials and parent advocates need an unbiased, knowledgeable expert consultation for an objective review of problems regarding educational programming for a handicapped child. The consultant should provide objective feedback which can be used as a basis for decision making. In addition, from the perspective of the school officials, such a consultant should be readily available at a reasonable cost (Parry & Ferrara, in press).

A Computer-based Solution

AI expert systems can provide school officials and parent advocates with expert advice as they attempt to develop complex instructional programs. What are artificial intelligence expert systems?

> Artificial intelligence is the part of computer science concerned with designing intelligent computer systems, that is, systems that exhibit the characteristics we associate with intelligence in human behavior--understanding, language, learning reasoning, solving problems, and so on (Barr & Feigenbaum, 1981, p. 3).

Artificial intelligence systems intended to replicate decision-making by knowledgeable and experienced humans are called expert systems. An expert system is typically set up to engage the user in a dialogue. This dialogue, in many ways, parallels the type of conversation a person might have with an expert consultant. The computer is programmed to ask the user questions to detail the problem or situation (Barr & Feigenbaum, 1981). For example, a well-known medical system for physicians is MYCIN (Davis, Buchanan & Shortliffe, 1975). With the MYCIN program the user feeds into the computer information on the characteristics of the patient's bacterial cultures and the patient's symptoms. The computer is programmed to match the patient's data with information in the program on the characteristics of bacterial cultures and then, based on programmed logic, present a disease diagnosis.

Mandate Consultant

A prototype expert system developed at Utah State Unviversity, focusing on administrative issues in special education is Mandate Consultant (Parry, 1985). Mandate Consultant is designed to provide school personnel and parents with a second opinion regarding the consistency of actions by school officials as they implement the IEP team process identified in regulations. Mandate Consultant employs rules based on the Education of All Handicapped Children Act, as implemented by P.L. 94-142, and Utah state rules and regulations. Users of the program can check their reasoning and conclusions against the outcome produced by decision rules programmed into

the computer. Users can obtain a printed record which describes the consultation. The record shows what questions the computer program presented, the answers the user provided, and the rules the program called on the computer to apply for making "decisions" based upon those answers.

Clearly, the identification of a handicapped student and the provision of appropriate special education programming is a complex process composed of many components. Thus, the current version of the Mandate Consultant focuses on the IEP team process, that is, the IEP team meeting and development of the IEP. This version contains a knowledge base of about 100 rules based on federal and state regulations regarding the IEP process. Experience of the AI staff supports the importance of an initial knowledge base of an efficient and manageable size, that is, probably no more than 200-300 rules initially. Once the structure and logic of the program have been successfully established with a selected component, other components can be added.

Mandate Consultant is an untested prototype. Nonetheless, designing and programming the Mandate Consultant expert system has helped to clarify a complex knowledge base of some of the procedures that lead to appropriate educational programs for the handicapped. A sound knowledge base, composed of federal and state regulations such as the one required for Mandate Consultant, holds potential for addressing many of the issues currently resolved at a due process hearing level. Unlike the range of decisions provided by human experts, the expert system

can provide consistent and reliable feedback for identical sets of input data (Colbourn, 1982). Furthermore, the expert system has potential as a training tool for educating hearing officers as well as interested school officials and parents.

A Closer Look at Mandate Consultant

When using Mandate Consultant, the user enters answers to a series of questions regarding implementation of the procedures for a student. Figure 1 shows an example of a typical consultation with Mandate Consultant. The questions contained in Figure 1 appear on the screen, followed by a prompt (>>). The user enters reponses and ends each with a period.

Mandate Consultant contains a knowledge base of approximately 100 rules. During the consultation, the program uses these rules to determine which questions to ask and, ultimately, which conclusion to infer. Figure 2 shows an example of a rule.

The rule in Figure 2 can be translated as follows: If the IEP includes a statement of annual-goals and short-term objectives for this student, and the goals and objectives are based on the unique needs of the student as indicated in the findings of the multidisciplinary evaluation, and the objectives are stated in measurable terms, and the goals and objectives describe the anticipated behavior for the student to achieve, then the annual goals and short-term objectives for this student, as stated on the IEP, should meet the requirements of the federal and/or state regulations.

Mandate Consultant uses backchaining to determine if rules

What is the student's current age in years?

>>17.

Was an IEP team meeting held for this student? (yes or no)

>>y.

Did a representative of the public agency, other than the student's teacher, attend the IEP team meeting? (yes or no)

>>y.

Did the student's teacher attend the IEP team meeting? (yes or no)

>>y.

Did the student's parent(s) attend the IEP team meeting? (yes or no)

>>y.

Did the public agency take whatever action was necessary to insure the parent(s) understood the proceedings at the IEP team meeting (for example, an interpreter for parents who are deaf or whose native language is other than English)? (yes, no, or unknown)

>>y.

Is this the first time the student was evaluated as a potential special education student? (yes or no)

>>no.

Is this student being considered for placement at a private school? (yes or no)

>>y.

Did a representative of the private school attend the IEP team meeting? (yes or no)

>>y.

Figure 1. Example of consultation using Mandate Consultant.

```
If annual-goals = yes
     and unique-needs-check = acceptable-unique-needs
     and measurable-objectives-check = acceptable-measurable-
       objective
     and describe-outcomes-check = acceptable-outcomes
     then iep-annual-goals = acceptable-annual-goals.
```

Figure 2. An example of a rule

succeed or fail. For example, when testing the rule stated in Figure 2, Mandate Consultant first seeks a value for the expression, "annual-goals." Then values for the expressions "unique-needs-check, measurable objectives-check and describe-outcomes-check" will be sought. Thus, if all the conditions of a rule are confirmed, the conclusion is confirmed and the rule succeeds. Conversely, if any of the conditions in a rule cannot be confirmed, the conclusion cannot be confirmed and the rule fails. Testing rules is but one way the computer program seeks values for expressions. As illustrated in Figure 3, there are three potential ways for the system to obtain a value for an expression: (1) check global memory; (2) try rules concluding with the expression, and (3) ask the user.

Figure 4 shows how Mandate Consultant tests a rule designed to review the portion of an IEP identifying the special education and related services to be provided for a student. Specifically, the rule determines if the services as stated on the IEP are consistent with the requirements of federal and state regulations. A numerical sequence is presented in Figure 4 showing the procedures used to test this rule. The following descriptions accompany the procedures:

1. Seeks a value for the expression "spec-ed-services" in the global memory. (The global memory contains information already known by the system.)
2. Returns "yes" as the value for "spec-ed-services."
3. Seeks a value for pe-check by using a rule which concludes in "then pe-check."

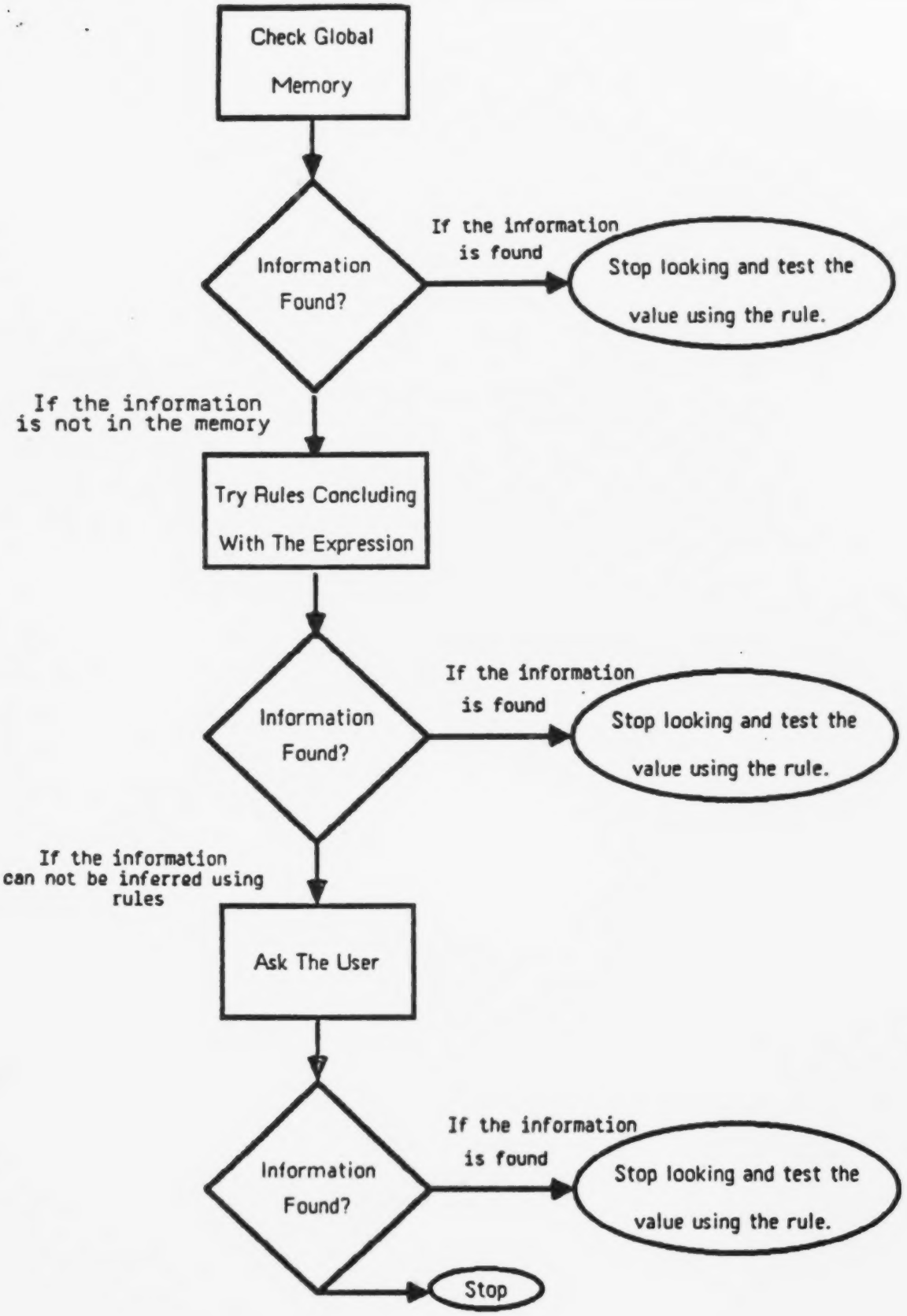
Check Global Memory
Information Found?
If the information is found
Stop looking and test the value using the rule.
If the information is not in the memory
Try Rules Concluding With The Expression
Information Found?
If the information is found
Stop looking and test the value using the rule.
If the information can not be inferred using rules
Ask The User
Information Found?
If the information is found
Stop looking and test the value using the rule.
Stop

Figure 3. Three ways to obtain a value for an expression.

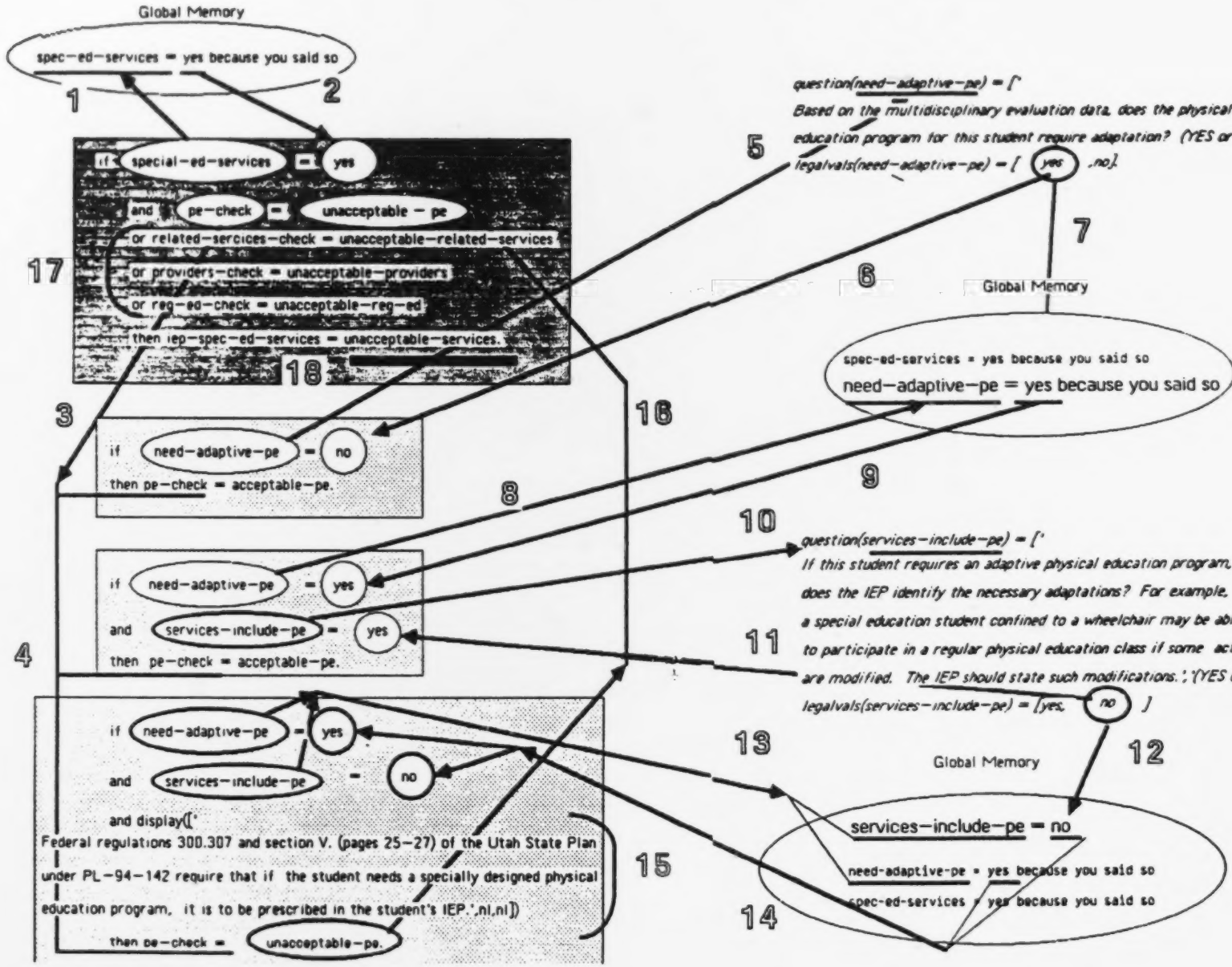
Global Memory
spec-ed-services = yes because you said so
1
2
if special-ed-services = yes
and pe-check = unacceptable - pe
or related-sercices-check = unacceptable-related-services
or providers-check = unacceptable-providers
or reg-ed-check = unacceptable-reg-ed
then iep-spec-ed-services = unacceptable-services.
17
18
3
if need-adaptive-pe = no
then pe-check = acceptable-pe.
8
if need-adaptive-pe = yes
and services-include-pe = yes
then pe-check = acceptable-pe.
4
if need-adaptive-pe = yes
and services-include-pe = no
and display([' Federal regulations 300.307 and section V. (pages 25-27) of the Utah State Plan under PL-94-142 require that if the student needs a specially designed physical education program, it is to be prescribed in the student's IEP.',nl,nl])
then pe-check = unacceptable-pe.
15
16
question(need-adaptive-pe) = ['
Based on the multidisciplinary evaluation data, does the physical education program for this student require adaptation? (YES or NO)',nl,nl]
legalvals(need-adaptive-pe) = [yes ,no].
5
7
6
Global Memory
spec-ed-services = yes because you said so
need-adaptive-pe = yes because you said so
9
10
question(services-include-pe) = ['
If this student requires an adaptive physical education program, does the IEP identify the necessary adaptations? For example, a special education student confined to a wheelchair may be able to participate in a regular physical education class if some activities are modified. The IEP should state such modifications.','(YES or NO)'].
11
legalvals(services-include-pe) = [yes, no]
13
Global Memory
12
services-include-pe = no
need-adaptive-pe = yes because you said so
spec-ed-services = yes because you said so
14

Figure 4. Example illustrating how Mandate Consultant tests a rule.

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4. Finds three rules concluding "pe-check," so proceeds to test each rule.
5. Seeks a value for the expression "need-adaptive-pe" by questioning the user.
6. Returns the user's value "yes" for the expression "need-adaptive-pe." Because the user's value of "yes" does not match the value "no" found in the first rule, this rule fails.
7. Enters "yes" in the global memory as the value for the expression "need-adaptive-pe."
8. Considers the next rule concluding "pe-check" and seeks a value for the expression "need-adaptive-pe" in the global memory.
9. Returns "yes" as the value for "need-adaptive-pe."
10. Seeks value for the expression "services-include-pe" by questioning the user.
11. Returns the user's value "no" for the expression "services-include-pe." Because the user's value of "no" does not match the value "yes" found in the second rule, this rule fails.
12. Enters "no" in the global memory as the value for the expression "services-include-pe."
13. Moves on to consider the third rule concluding "pe-check" and seeks values for the expressions "need-adaptive-pe" and "services-include-pe" in the global memory.
14. Returns "yes" as the value for "need-adaptive-pe" and "no " as the value for "services-include-pe."

15. The message included in the rule is displayed to the user.

16. The rule succeeds, and the expression "pe-check" is given the value "unacceptable-pe."

17. Seeks the values of the expressions in the subsequent premises in the same manner that the value for pe-check was sought.

18. The rule succeeds or fails, depending on the outcome of the expressions in the premises.

There are two ways in which consulatation with the Mandate Consultant program can be ended.

The "voluntary-end." In a "voluntary-end" situation, Mandate Consultant establishes that the information provided by the user indicates a substantial weakness in the IEP team process. Recognizing that a valid and complete review of implementation of the special education procedures is limited by the identified weakness, the user can voluntarily end the consultation. An illustration of a "voluntary-end" is included as Figure 5. Mandate Consultant follows these steps:

1. Seeks a value for the expression "iep-team-mtg" by asking the user a question.

2. Returns the user's value "no" for the expression "iep-team-mtg."

3. The message included in the rule is displayed to the user.

4. Seeks a value for the expression "go-on" by asking the user a question.

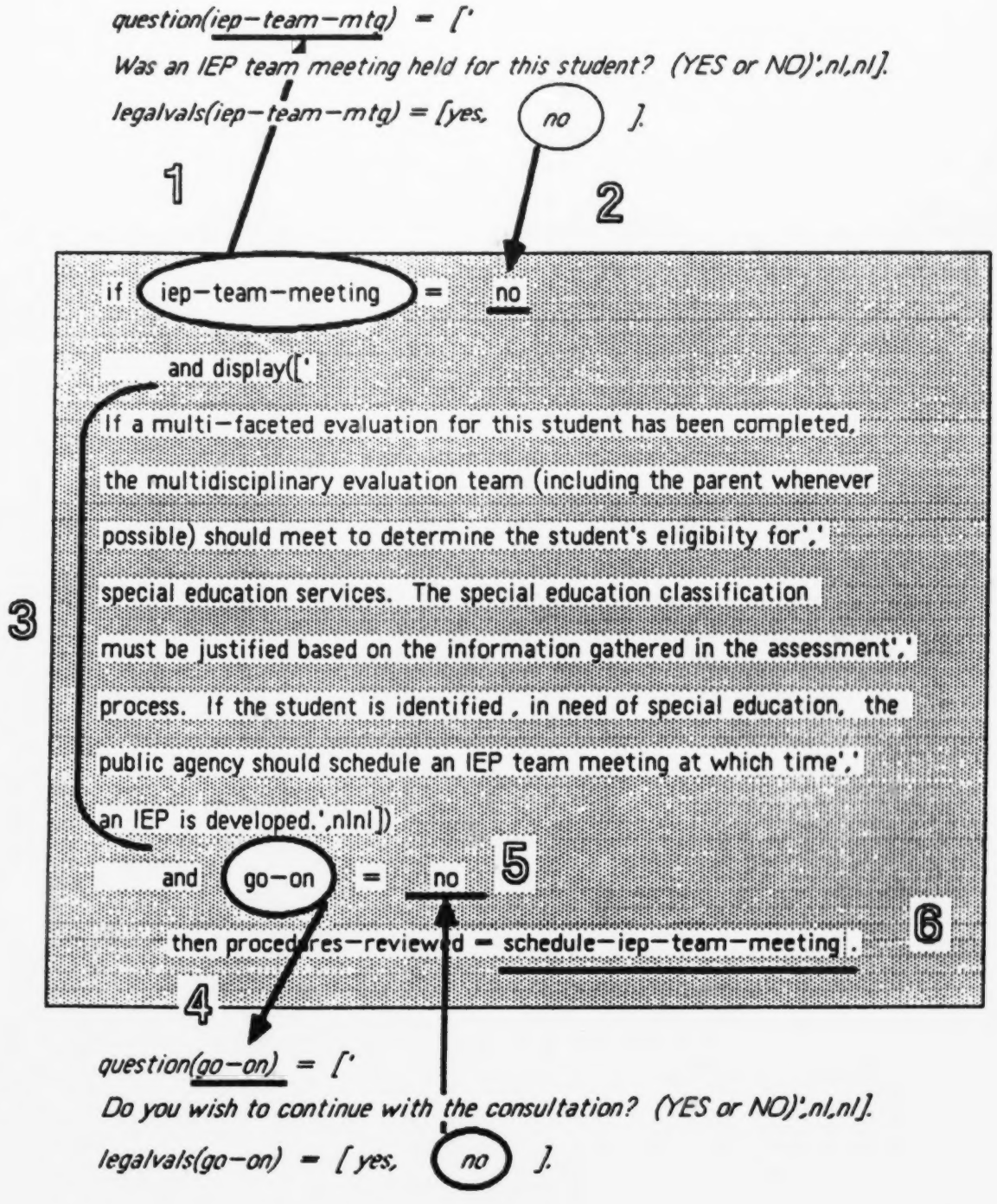
question(iep-team-mtg) = ['
Was an IEP team meeting held for this student? (YES or NO)',nl,nl].
legalvals(iep-team-mtg) = [yes, no].
1
2
if iep-team-meeting = no
and display(['
If a multi-faceted evaluation for this student has been completed,
the multidisciplinary evaluation team (including the parent whenever
possible) should meet to determine the student's eligibilty for',',
special education services. The special education classification
must be justified based on the information gathered in the assessment',',
process. If the student is identified , in need of special education, the
public agency should schedule an IEP team meeting at which time',',
an IEP is developed.',nlnl])
3
and go-on = no
5
then procedures-reviewed = schedule-iep-team-meeting.
6
4
question(go-on) = ['
Do you wish to continue with the consultation? (YES or NO)',nl,nl].
legalvals(go-on) = [yes, no].

Figure 5. Example of a voluntary end.

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5. Seeks the user's value "no" for the expression "go-on."
6. The rule succeeds and the consultation ends since the goal of the program, i.e., "procedures-reviewed," has been concluded.

"Procedures-reviewed." When the system has collected enough information to complete a review of the implementation of special eductional procedures for a student, the results of the review appear on the computer monitor and the consultation ends. Figure 6 shows an example of the system's output at the conclusion of a consultation. The display includes eight summary statements with the level of certainty which may be attached to each element of the review.

Additional Features

The M.1 authoring system used to create Mandate Consultant has several features which make the system particularly attractive to educators.

1. The "TRACE" facility allows the user to track and monitor the computer logic as the program attempts to determine advice.
2. The "WHY" facility allows the user to inquire about "why" the program asked a question. The machine's response might include an M.1 rule, an English translation of an M.1 rule, or a reference to state and/or federal law.
3. The "SHOW' facility allows the user to query the program at any point in the consultation regarding its immediate conclusions.

The IEP team meeting for this student failed to include all the participants required by the regulations.

procedures-reviewed = insufficient-iep-team (80%) because kb-86.

The public agency's notification to the parent regarding the IEP team meeting failed to meet the requirements of the regulations.

procedures-reviewed = unacceptable-parent-notification (80%) because kb-86.

The public agency failed to insure the parent's involvement in the IEP team process. When a parent is unable to attend the meeting, the public agency must attempt and document alternative means of involving the parent in order to meet the requirement of the regulations.

procedures-reviewed = inadequate-parent-followup (89%) because kb-86.

Acquisition of the parent's approval by signature for the proposed placement of the student in special education should meet the requirement of the regulations.

procedures-reviewed = yes-placement-sign (99%) because kb-86.

The IEP team developed an IEP for this student, but the IEP was not developed within the thirty day requirement, as stated by the state rule.

procedures-reviewed = delayed-iep-dev (69%) because kb-86.

The IEP has weak or missing components that are required by the regulations.

procedures-reviewed = deficient-iep-components (83%) because kb-86.

The signatures of all the IEP team members on the IEP meets the requirement of the state rule.

procedures-reviewed = acceptable-sign (89%) because kb-86.

The public agency failed to acquire parental consent by signature on the IEP prior to placement and initiation of services as required by the regulations.

procedures-reviewed = unacceptable-prior-consent (99%) because kb-86.

Figure 6. Example of display at the conclusion of the consultation.

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